US009415969B2

(12) **United States Patent**
Fritsch et al.

(10) **Patent No.: US 9,415,969 B2**
(45) **Date of Patent: Aug. 16, 2016**

(54) **METHOD FOR CONTROLLING A FEEDER OF A GATHERING-STITCHING MACHINE**

(71) Applicant: **MUELLER MARTINI HOLDING AG**, Zofingen (CH)

(72) Inventors: **Stephan Fritsch**, Frauenfeld (CH); **Steffen Hoffmann**, Leipzig (DE); **Falk Preuss**, Leipzig (DE)

(73) Assignee: **Mueller Martini Holding AG**, Zofingen (CH)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/714,709**

(22) Filed: **Dec. 14, 2012**

(65) **Prior Publication Data**

US 2013/0154177 A1 Jun. 20, 2013

(30) **Foreign Application Priority Data**

Dec. 14, 2011 (DE) 10 2011 120 994

(51) **Int. Cl.**
B65H 5/12 (2006.01)
B65H 39/00 (2006.01)
B42C 1/12 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B65H 39/00*** (2013.01); ***B42B 4/00*** (2013.01); ***B42B 9/02*** (2013.01); ***B42B 9/04*** (2013.01); ***B42C 1/12*** (2013.01); ***B65H 3/0875*** (2013.01); ***B65H 5/307*** (2013.01); ***B65H 5/32*** (2013.01); ***B65H 39/043*** (2013.01); ***B65H 39/055*** (2013.01); *B65H 2301/322* (2013.01); *B65H 2511/415* (2013.01); *B65H 2513/50* (2013.01); *B65H 2701/1932* (2013.01)

(58) **Field of Classification Search**
CPC B42B 4/00; B65H 5/12
USPC 270/52.14, 52.15, 52.16, 52.17, 52.18, 270/52.19, 52.2, 52.21, 52.22, 52.23, 52.24, 270/52.25, 52.26, 52.27, 52.28, 52.29, 52.3, 270/56
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,078,784 A * 3/1978 Miaskoff et al. 270/56
4,162,066 A * 7/1979 McCain et al. 271/5
(Continued)

FOREIGN PATENT DOCUMENTS

DE 1 100 043 B 2/1961
DE 42 21 929 C2 11/1997
(Continued)

OTHER PUBLICATIONS

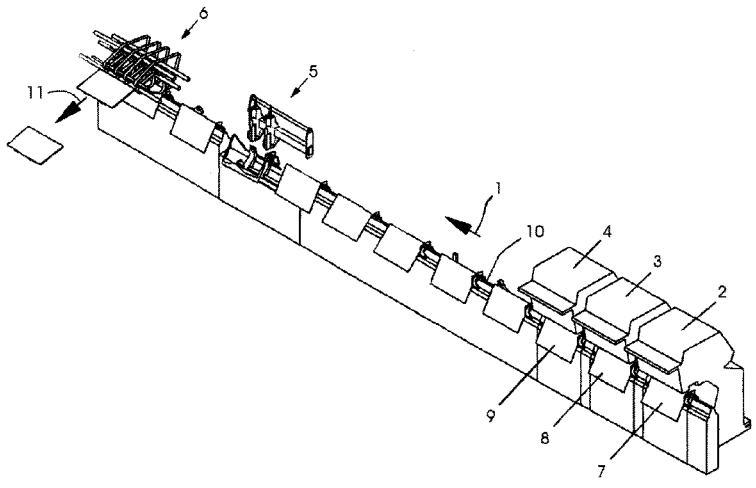
German Patent and Trademark Office Search Report Dated Nov. 8, 2012.

Primary Examiner — Patrick Mackey
(74) *Attorney, Agent, or Firm* — Laurence A. Greenberg; Werner H. Stemer; Ralph E. Locher

(57) **ABSTRACT**

A method for controlling a feeder of a gathering-stitching machine reduces the operating effort when setting the feeder, increases reliability when laying folded sheets on a transport device and improves quality during collating and stitching. Opening and closing times of grippers are regulated under program control, continuously and as a function of format when controlling the feeder of the gathering-stitching machine. Data relating to the dimensions and to the number of pages of the folded sheets is thus entered into a control device, from which data actuating signals for actuating elements of the grippers are generated.

9 Claims, 6 Drawing Sheets



(51) **Int. Cl.**

B42B 4/00	(2006.01)
B42B 9/02	(2006.01)
B42B 9/04	(2006.01)
B65H 3/08	(2006.01)
B65H 5/30	(2006.01)
B65H 5/32	(2006.01)
B65H 39/043	(2006.01)
B65H 39/055	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,844,433	A *	7/1989	Hastie	270/52.27
5,029,832	A *	7/1991	Orsinger et al.	270/58.06
5,042,232	A *	8/1991	Orsinger et al.	53/460
5,333,547	A *	8/1994	Pfisterer	B65H 5/14 101/232
5,390,601	A *	2/1995	Fricke	B41F 21/10 101/409
5,447,302	A *	9/1995	Curley	B65H 5/14 271/11
5,518,231	A *	5/1996	Reddy	B65H 5/14 271/204
5,893,824	A *	4/1999	Schlough	B65H 5/12 270/52.27
6,175,775	B1	1/2001	Grunder	
7,234,694	B2 *	6/2007	Richter et al.	270/52.26
7,451,969	B2 *	11/2008	Bottcher	B42B 4/00 270/52.14
7,510,184	B2 *	3/2009	Kaya	B65H 5/12 271/176
7,748,517	B2 *	7/2010	Caunter	B65H 5/12 198/468.2
7,812,853	B2 *	10/2010	Altenbach	B41F 21/12 347/236
8,061,702	B2 *	11/2011	Caunter	270/52.26
2007/0228633	A1 *	10/2007	Hoffmann	B42B 9/02 270/52.25
2013/0285306	A1 *	10/2013	Zuech et al.	271/10.09

FOREIGN PATENT DOCUMENTS

DE	197 52 015	A1	5/1999
DE	198 41 265	A1	3/2000
EP	0 749 927	A1	12/1996
EP	0917965	A1	5/1999
EP	1525998	A2	4/2005

* cited by examiner

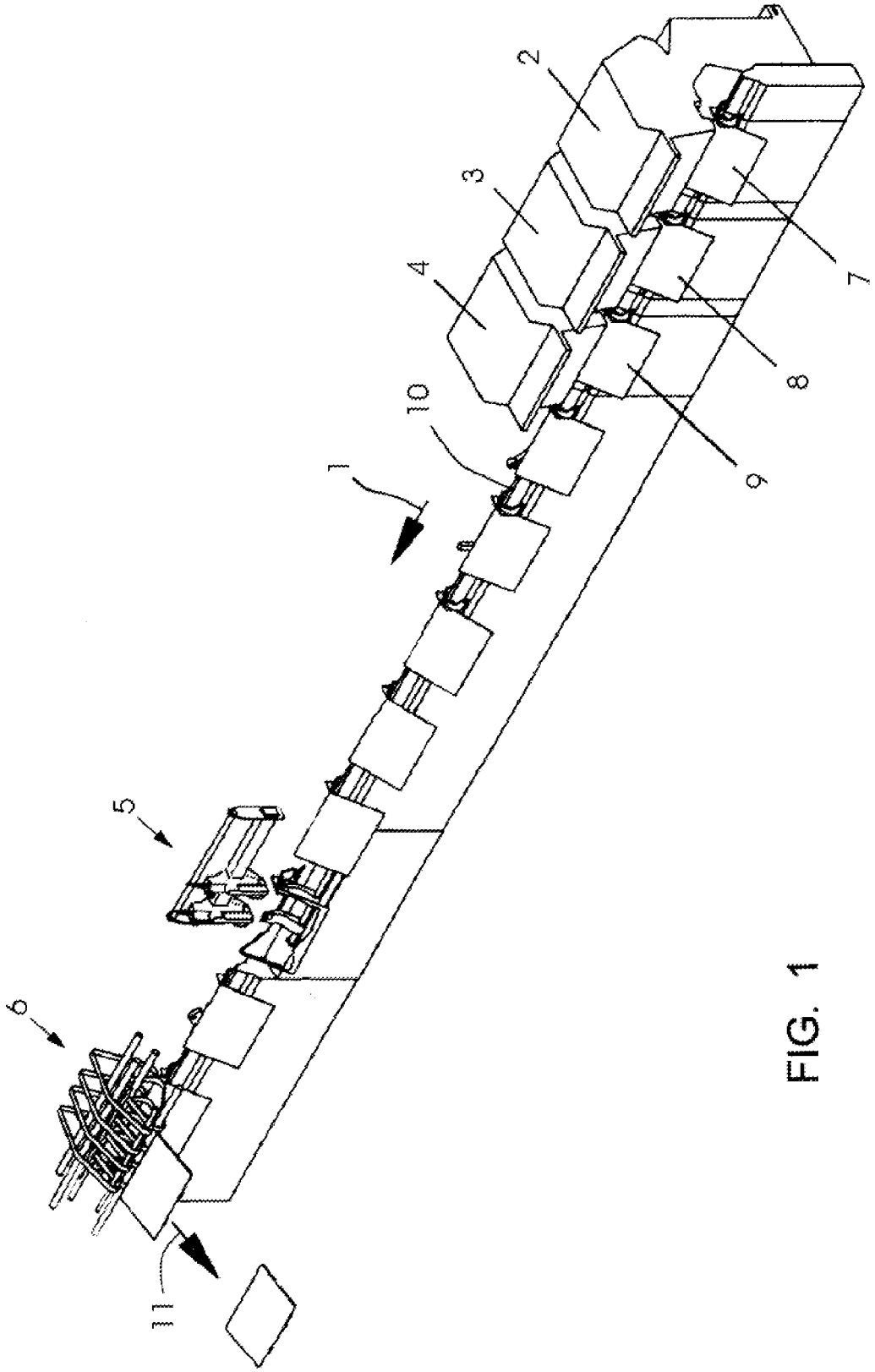


FIG. 1

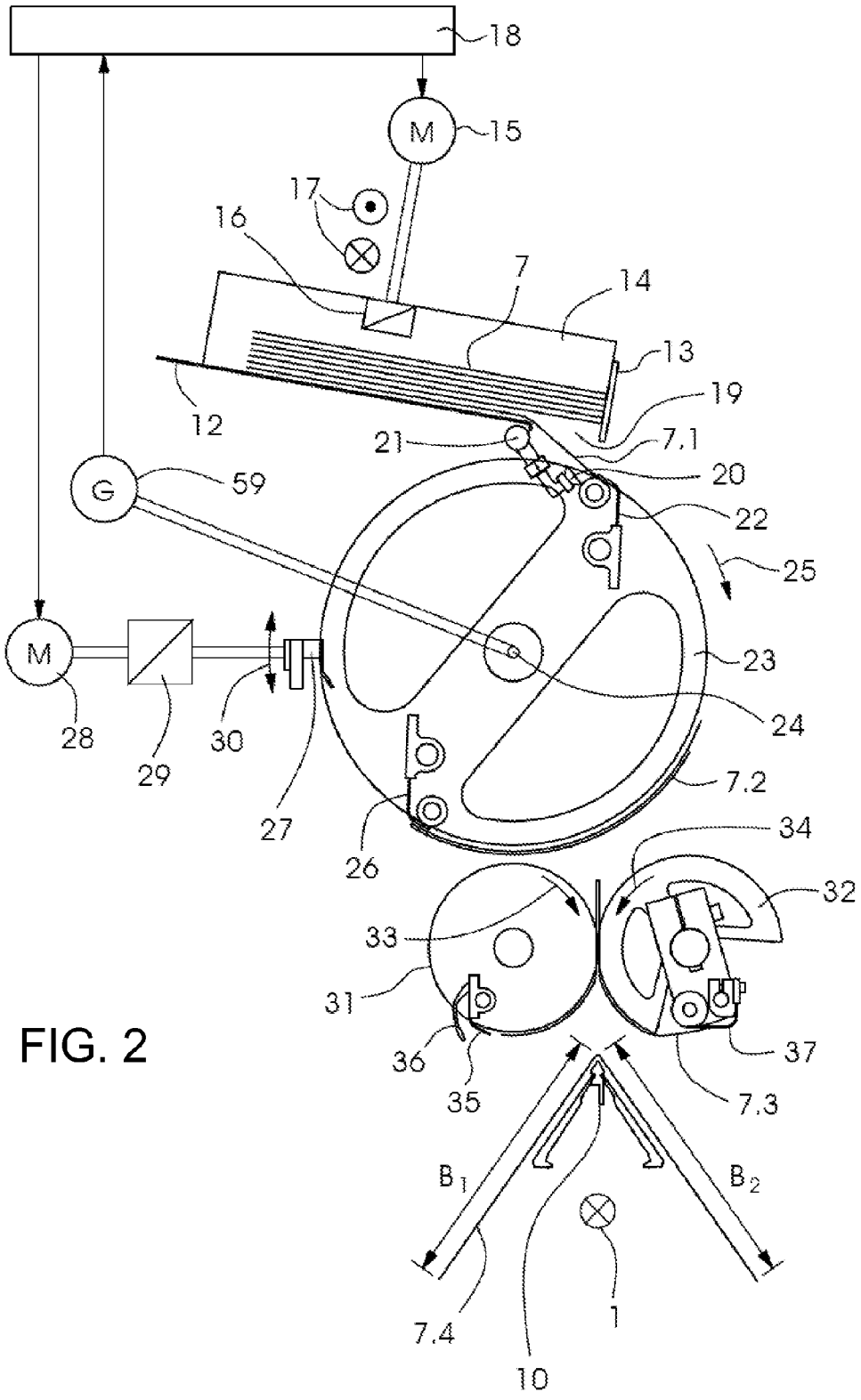

18
M
15
17
16
7
14
13
19
12
21
7.1
G
59
20
22
25
M
23
24
28
29
30
27
26
7.2
34
32
33
31
36
35
37
7.3
B1
B2
7.4
10
1

FIG. 2

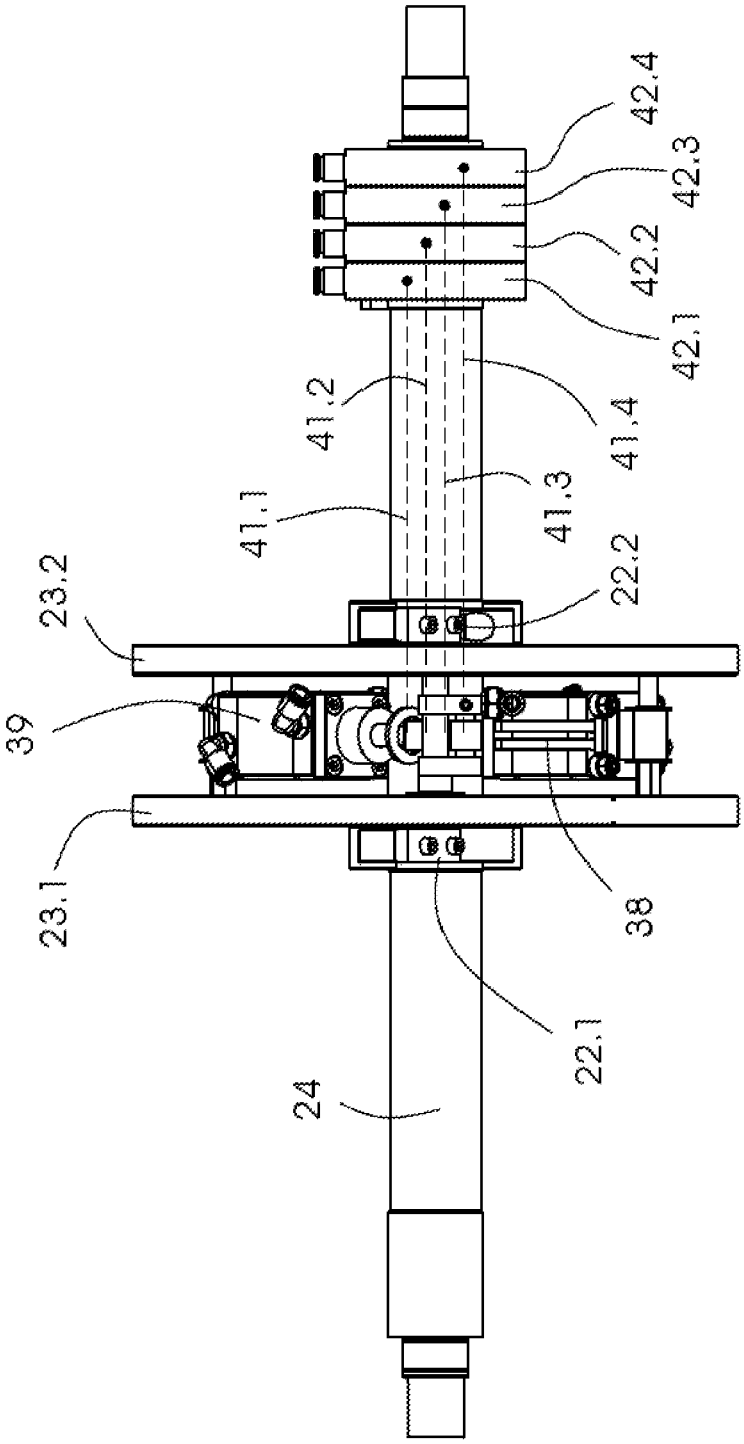


FIG. 3

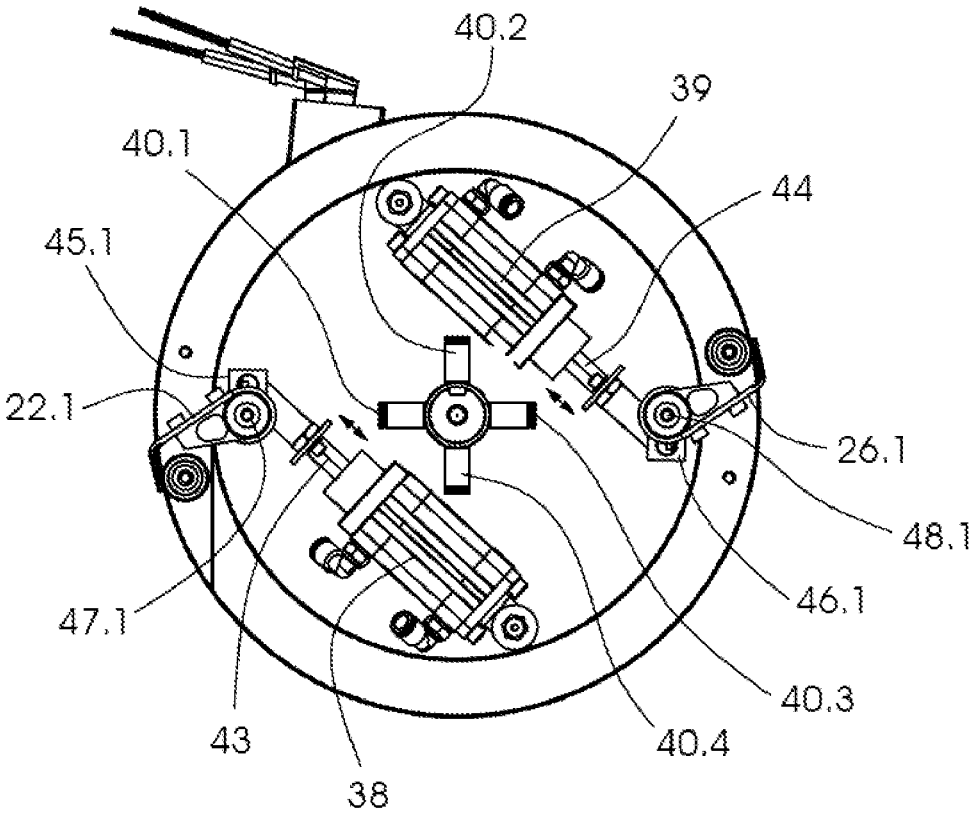


FIG. 4

FIG. 5.1

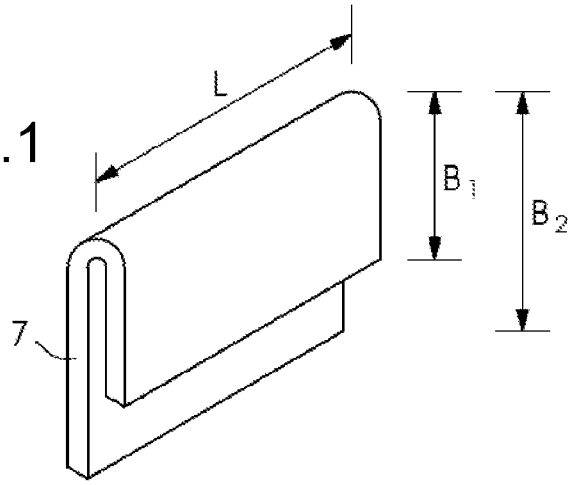


FIG. 5.2

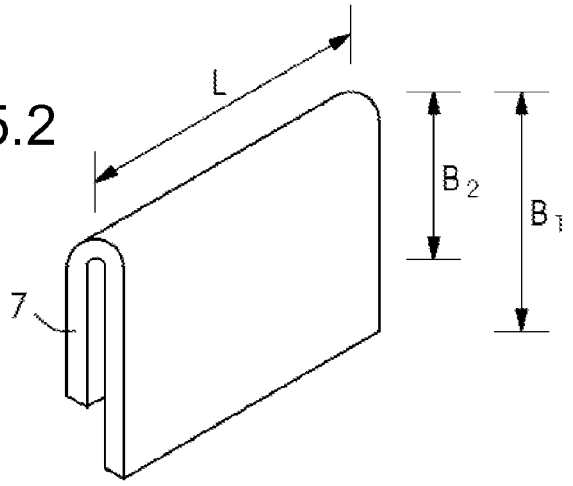
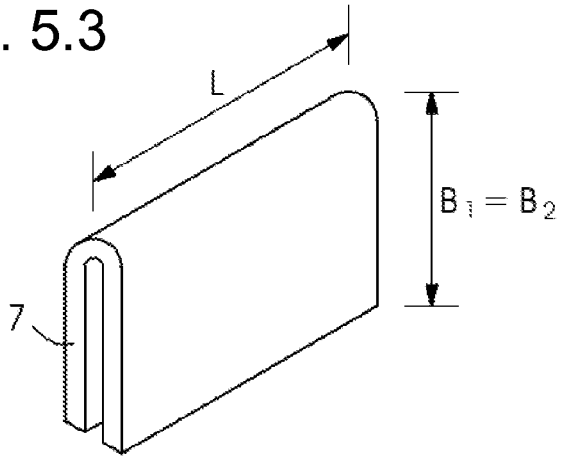


FIG. 5.3



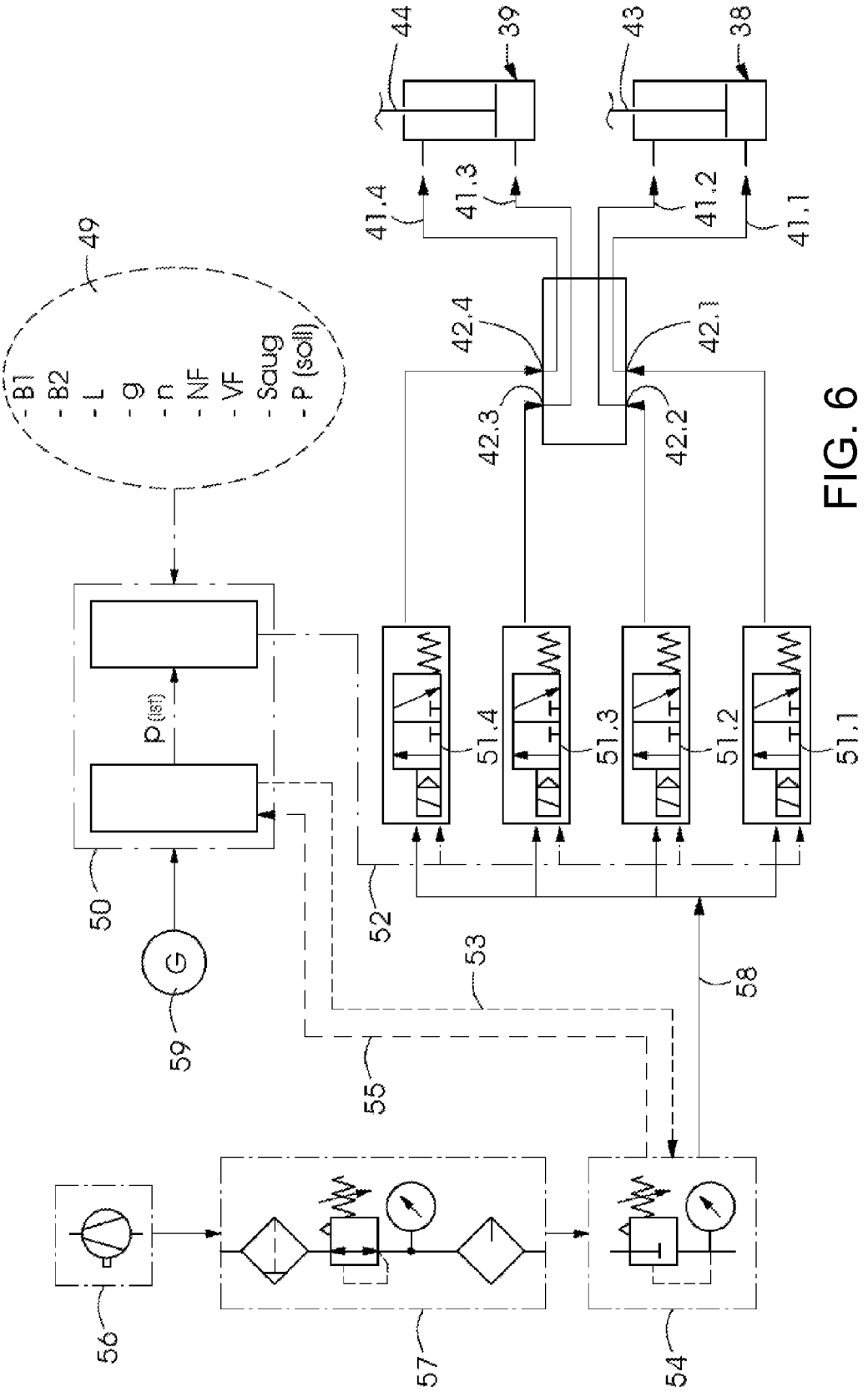

44
39
43
38
41.4
41.3
41.2
41.1
49
42.4
42.1
42.3
42.2
B1
B2
L
g
n
NF
VF
Saug
P (soll)
P (ist)
51.4
51.3
51.2
51.1
50
52
53
58
G
59
55
56
57
54

FIG. 6

METHOD FOR CONTROLLING A FEEDER OF A GATHERING-STITCHING MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the priority, under 35 U.S.C. §119, of German Patent Application DE 10 2011 120 994.1, filed Dec. 14, 2011; the prior application is herewith incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a method for controlling a feeder of a gathering-stitching machine, in which folded sheets are separated one after another by at least one gripper from a stack of a magazine and laid on a transport device, and opening and closing the gripper and actuating a stitching device are carried out under remote control by actuating signals from a control device.

German Published, Prosecuted Patent Application DE 1 100 043 discloses a gripper for a bookbinding machine for gripping and firmly holding sheets, the closing movement of which is initiated by actuating a pneumatic operating cylinder. If the operating cylinder is placed under vacuum or pressurized with compressed air, then a gripper finger fixed to a piston rod is drawn-in counter to the force of a spring. The pressurized or vacuum air is fed to the operating cylinder through a control valve, which is controlled by an adjustable cam disk in such a way that the gripper force is regulated. A cam disk has a fixed actuating characteristic corresponding to the cam curve. No details relating to the adjustment of the cam disk are disclosed in that application.

In printing presses, it is also known from German Patent DE 42 21 929 C2, corresponding to U.S. Pat. No. 5,390,601, to control the movement of grippers connected to a drum by using a computer, so that rapid adaptation to changing operating conditions is possible, and the gripper force can be set as a function of the printing material. The gripper movements are controlled with a pneumatic piston-cylinder unit, with the actuating position of the piston being regulated with the aid of a displacement measuring system as a function of the rotational angle of the drum, through the use of a set point/actual comparison. In the patent, there is no more detailed explanation as to which printing material characteristic variables play a role in calculating actuating positions of the piston.

A gatherer-stitcher described in German Published, Non-Prosecuted Patent Application DE 197 52 017 A1 includes a plurality of folded sheet feeders. The rotational speed of the drums of a feeder can be retarded or accelerated, depending on the paper quality, with the speed of a gatherer chain being uniform.

A gatherer-stitcher described in German Published, Non-Prosecuted Patent Application DE 198 41 265 A1 reveals the provision of sensors which measure the length and width of the folded sheets in a feeder of the gatherer-stitcher. A register stop can be set automatically by using the sensor signals. The grippers holding the folded sheets during a delivery are conventionally actuated through the use of a cam mechanism.

SUMMARY OF THE INVENTION

It is accordingly an object of the invention to provide a method for controlling a feeder of a gathering-stitching machine, which overcomes the hereinafore-mentioned disadvantages of the heretofore-known methods of this general type, which reduces the operating effort when setting the feeder, which increases the reliability when laying folded sheets on a transport device and which improves the quality during collating and stitching.

With the foregoing and other objects in view there is provided, in accordance with the invention, a method for controlling a feeder of a gathering-stitching machine. The method comprises separating folded sheets one after another from a stack of a magazine using at least one gripper, laying the separated folded sheets on a transport device, opening and closing the at least one gripper and actuating a stitching device under remote control using actuating signals from a control device, and generating the actuating signals from data relating to dimensions and number of pages of the folded sheets.

According to the invention, when controlling a feeder of a gathering-stitching machine, the opening and closing times of grippers are regulated under program control, continuously and as a function of format. For this purpose, data relating to the dimensions and to the number of pages of the folded sheets is entered into a control device, from which data actuating signals for actuating elements of the grippers are generated. As a result of the automated separation of folded sheets, it is possible to vary the switching and reaction times on a product basis. When pneumatic controllers are used, the number of mechanical components can be reduced, so that low production costs arise. As a result of a low number of mechanical wearing points, the reliability of the feeder is improved. Marks on the folded sheets can be avoided, in that the gripping forces can be set variably.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in a method for controlling a feeder of a gathering-stitching machine, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. **1** is a diagrammatic, perspective view of a gathering-stitching machine having a plurality of feeders;

FIG. **2** is a cross-sectional view of a feeder;

FIG. **3** is a side-elevational view of a separating drum with pneumatic operating cylinders;

FIG. **4** is a cross-sectional view showing a pair of grippers of a separating drum, operated by operating cylinders;

FIGS. **5.1-5.3** are perspective views of folded sheets and dimensions thereof; and

FIG. **6** is a schematic diagram of a control device for a feeder.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the figures of the drawings in detail and first, particularly, to FIG. **1** thereof, there is seen a gathering-stitching machine which includes, inter alia, three feeders **2-4** disposed one after another in a production direction **1**, a

stitching station **5** and a cross-conveyor **6**. Folded sheets **7-9** which are separated in the feeders **2-4** are laid one above another astride on an endlessly circulating gathering chain **10** and are conveyed to the stitching station **5**. In the stitching station **5**, the collated folded sheets **7-9** are joined to one another by spine wire stitching. After the cross-conveyor **6**, the folding sheets **7-9** which are joined to one another are given a new production direction **11** for onward transport to a trimmer.

As is seen from the sectional illustration of the feeder **3** in FIG. **2**, folded sheets **7** are located in such a way as to be stacked one above another in a magazine **12**. The base of the magazine **12** lies at an angle to the horizontal. The folded sheets **7** rest with their folded leading edges on a register rail **13** and with their side edges on lateral edge stops **14**. The lateral stops **14** can be set to a spine length L of the folded sheets **7** through the use of a motor **15** and a spindle drive **16** in a direction **17** at right angles to the plane of the sheet. The motor **15** is connected to a control device **18**.

In order to separate the folded sheets **7** from the underside of the folded sheet stack, suction grippers **20** are disposed underneath an opening **19** in the base of the magazine **12**. The suction grippers **20** are fixed to a hollow shaft **21** and can be pivoted about an axis of the hollow shaft **21** at a separation cycle rate.

FIG. **2** illustrates a situation in which a separated folded sheet **7.1** has been transferred from the suction grippers **20** into mechanical grippers **22** of a separating drum **23**. The separating drum **23** rotates about its shaft **24** in a direction **25**. A folded sheet **7.2** preceding the separated folded sheet **7.1** is held in further mechanical grippers **26** of the separating drum **23**. The grippers **26** are located diametrically opposite the grippers **22** in relation to the shaft **24**.

During a further rotation of the separating drum **23** in the direction **25**, the folded sheet **7.2** comes with its leading edge against a pocket-like stop **27**. The stop **27** can be pivoted about the shaft **24** in a direction **30** in a manner corresponding to folded sheet widths B**1**, B**2** by a motor **28** and a gearbox **29**. The motor **28** is connected to the control device **18**.

Two further drums **31**, **32**, which are disposed underneath the separating drum **23**, rotate in opposite directions as shown by the direction of arrows **33**, **34**. FIG. **2** shows a situation in which a folded sheet **7.3** preceding the folded sheet **7.2** is opened through the use of the drums **31**, **32**. While the folded sheet **7.3** lies with its leading edge against the stop **27**, the ends of the folded sheet **7.3** running after it on the separating drum **23** were gripped by double grippers **35**, **36** of the drum **31**. The lap of the folded sheet **7.3** has been transferred from the top grippers **36** to grippers **37** of the opener drum **32**. The folded sheet **7.3** is drawn apart at the ends and allowed to fall over the gathering chain **10**. The folded sheet **7.3** is laid over a folded sheet **7.4**, which has already been laid on the gathering chain **10** through the use of the feeder **2**.

FIGS. **3** and **4** show a pneumatic controller of the movement of the grippers **22**, **26** of the separating drum **23**. The separating drum **23** includes two drum disks **23.1**, **23.2**, which are seated in a rotationally fixed manner on the hollow shaft **24**. Disposed between the disks **23.1**, **23.2** are pneumatic operating cylinders **38**, **39**, from each of which two respective pneumatic control lines **40.1-40.4** lead to channels **41.1-41.4** in the interior of the shaft **24**. A supply of compressed air for the operating cylinders **38**, **39** is carried out through rotary lead-throughs **42.1-42.4**, each disposed at the end of a respective channel **41.1-41.4**. Operating piston rods **43**, **44** of the operating cylinders **38**, **39** are connected to levers **45.1**, **45.2**, **46.1**, **46.2**, which are seated in a rotationally fixed manner on gripper shafts **47.1**, **47.2**, **48.1**, **48.2** of the grippers **22**, **26**. A pair of grippers **22.1**, **26.1**; **22.2**, **26.2** is disposed on each disk **23.1**, **23.2**. As the piston rods **43**, **44** are moved in and out of the operating cylinders **38**, **39**, the gripper shafts **47**, **48** have a torque applied to them which effects closing and opening of the grippers **22**, **26**.

The grippers **22**, **26** are opened and closed on the basis of the dimensions and the number of pages n of the folded sheets **7**. Depending on whether a trailing fold sheet NF with $B_1<B_2$, (FIG. **5.1**), a leading fold sheet VF with $B_1>B_2$ (FIG. **5.2**) or a folded sheet with equal fold widths with $B_1=B_2$ (FIG. **5.3**) is involved, the dimensions illustrated in FIG. **5** are taken into account. Further dimension-based data are the sheet thickness d and the grammage G.

The performance of the method is to be described below by using the schematic diagram illustrated in FIG. **6**:

The control device **18** includes, inter alia, an input device **49** for operator entries, which is connected to a computer **50**. The computer **50** contains a memory for operator entries relating to the following variables: sheet width B**1**, sheet width B**2**, spine length L, grammage g, number n of pages, type of fold such as trailing fold sheet NF, leading fold sheet VF or sucker sheet suck, and pressure set point $p_{(sp)}$.

In the computer **50**, the variables which are entered are processed and lead to pre-setting of various elements in the feeders **2-4**. The spine length L results in a pre-setting of the side stops **14** on the magazine **12** by using the motor **15**. The sheet width B**2** leads to a pre-setting of the register stop **27** using the motor **28** and of the gripper opening angle α_o of the grippers **22**, **26** on the separating drum **23**. Both sheet widths B**1**, B**2** are used in order to preset the gripper closing angle α_c of the grippers **35-37** on the drums **31**, **32**. The spine length L, the sheet widths B**1**, B**2** and the sheet thickness d result in a pre-setting of a thickness monitoring device, a wire feed and a clincher tool belonging to the stitching station **5** and a height of a stepper belt. The gripping forces F of the grippers **22**, **26** of the separating drum **23** are preset by using the sheet thickness d. The predefined pressure set point $p_{(sp)}$ exerts some influence in presetting the gripping force F and the switching time t_{sw} of two-way valves **51.1-51.4**, which are connected to the rotary lead-throughs **42.1-42.4**. The switching time t_{sw} of the valves **51.1-51.4** is controllable, for which purpose there is a connection **52** between the valves **51.1-51.4** and the computer **50**.

The pressure set point $p_{(sp)}$ is transmitted through a connection **53** from the computer **50** to a pressure controller **54**. The actual pressure $p_{(act)}$ is transmitted from the pressure controller **54** through a connection **55** to the computer **50**, where a comparison with the pressure set point $p_{(sp)}$ is carried out continuously. If the pressure set point $p_{(sp)}$ and actual pressure $p_{(act)}$ agree, the switching time t_{sw} remains constant. If $p_{(act)}>p_{(sp)}$, the switching time t_{sw} required for this actual pressure $p_{(act)}$ is passed on to the valves **51.1** to **51.4**. Furthermore, the information to reduce the pressure p_{sp} is transmitted to the pressure controller **54**. If $p_{(act)}<p_{(sp)}$ then the switching time t_{sw} required for this pressure $p_{(act)}$ is likewise transmitted to the valves **51.1-51.4** and the information to increase the pressure to $p_{(sp)}$ is passed on to the pressure controller **54**. With the aid of the pressure controller **54** and the feedback of $p_{(act)}$, it is possible to ensure that the gripper opening angles and gripper closing angles needed for sheet separation continually remain constant.

In addition to the $p_{(sp)}$ calculated in accordance with the program, provision is made that an operator can at any time during the operation manually predefine the desired positive pressure $p_{(sp)}$ individually for each feeder **2-4** without dis-

rupting the running production. Following the manual intervention, the regular set point-actual comparison between $p_{(sp)}$ and $p_{(act)}$ is again carried out.

All of the settings and changes are stored in the computer **50**. In the case of identical subsequent jobs, this data can be retrieved. This reduces the setup time, so that the operating costs are reduced.

The compressed air for actuating the grippers **22**, **26** is provided by a pump **56**, which is connected to the pressure controller **54** through a maintenance unit **57**. The compressed air is provided from the pressure controller **54** to the valves **51.1**-**51.4** through a connection **58** which, in accordance with the two-way switching, passes on the compressed air through the rotary lead-throughs **42.1**-**42.4** to the operating cylinders **38**, **39**. The drive of the drums **23**, **31**, **32** is carried out synchronously through the use of the control device **18**, with a rotary encoder **59** on the shaft **24** being used to output the current rotational speed and the current rotational angle a of the drum **23** to the control device **18** and to the computer **50**.

The invention is not restricted to the exemplary embodiment described. Automatic control of the gripper movements can also be carried out for the grippers **35** to **37** of the drums **31** to **32**. Instead of pneumatic actuating elements, it is also possible for electric or electromagnetic actuating elements to be used.

The invention claimed is:

1. A method for controlling a feeder of a gathering-stitching machine, the method comprising the following steps:

separating folded sheets one after another from a stack of a magazine using at least one gripper;

opening and closing the at least one gripper using actuating signals from a control device;

generating the actuating signals for opening and closing the at least one gripper from data relating to dimensions and number of pages of the folded sheets; and

using a fold width dimension for setting a gripper opening angle of the at least one gripper.

2. The method according to claim **1**, which further comprises fixing the at least one gripper to a revolving element, and additionally generating the actuating signals from signals from a rotary encoder supplying output signals reproducing a rotational position of the revolving element.

3. The method according to claim **1**, which further comprises actuating the at least one gripper using at least one pneumatically controllable operating cylinder.

4. The method according to claim **1**, wherein the dimensions of the fold widths are a trailing fold sheet, a leading fold sheet, or equal fold widths.

5. The method according to claim **1**, further comprising using the fold width dimension for presetting a pocket stop on separating drum carrying the at least one gripper.

6. A method for controlling a feeder of a gathering-stitching machine, the method comprising the following steps:

separating folded sheets one after another from a stack of a magazine using at least one gripper;

opening and closing the at least one gripper using actuating signals from a control device; and

generating the actuating signals for opening and closing the at least one gripper from data relating to dimensions and number of pages of the folded sheets, the dimensions including dimensions of fold widths of the folded sheets; and

using the dimensions of the fold widths for setting a gripper closing angle of the at least one gripper.

7. The method according to claim **6**, which further comprises fixing the at least one gripper to a revolving element, and additionally generating the actuating signals from signals from a rotary encoder supplying output signals reproducing a rotational position of the revolving element.

8. The method according to claim **6**, which further comprises actuating the at least one gripper using at least one pneumatically controllable operating cylinder.

9. The method according to claim **6**, wherein the dimensions of the fold widths are a trailing fold sheet, a leading fold sheet, or equal fold widths.

* * * * *